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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/722,312	11/25/2003	Byung Hyun Jung	20061/OF03P197	9304

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EXAMINER

GURLEY, LYNNE ANN

ART UNIT

PAPER NUMBER

2812

DATE MAILED: 08/06/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/722,312

Applicant(s)

JUNG ET AL.

Examiner

Lynne A. Gurley

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 25 November 2003.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-12 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-12 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.


Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.


LYNNE A. GURLEY
PRIMARY PATENT EXAMINER
TC 2800, AU 2812

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date 11/25/03
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Priority

1. Receipt is acknowledged of papers submitted under 35 U.S.C. 119(a)-(d), which papers have been placed of record in the file.

Information Disclosure Statement

2. The information disclosure statement (IDS) submitted on 11/25/03 was in compliance with the provisions of 37 CFR 1.97. Accordingly, the information disclosure statement is being considered by the examiner.

Specification

3. The specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

Claim Rejections - 35 USC § 102

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

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5. Claims 1-3, 5-7 and 11 are rejected under 35 U.S.C. 102(e) as being anticipated by Noguchi (US 2003/0114000, dated 6/19/03, filed 11/14/02).

6. Noguchi shows the method as claimed in figures 1-27 and corresponding text, with emphasis on figures 7-17 and corresponding text, as: forming a contact hole 16a in an insulating layer 15a/11b/12b [0211]; filling the contact hole with a copper layer 18a [0214]; planarizing the copper layer (figure 9; [0215]); removing a copper oxide layer parasitically formed on the copper layer [0217]-[0219] and [0232]; depositing a copper barrier layer 15b (figure 15) on the insulating layer and the copper layer; depositing an upper insulating layer 11c/12c on the copper barrier layer (figure 17); forming an upper contact hole (figure 17, leftmost contact hole from L3 to L2) in the copper barrier layer and the upper insulating layer to expose the copper layer. Removing the copper oxide layer exposes a surface of the copper layer and further comprises forming a copper nitride on the surface of the copper layer [0232]. Removing the copper oxide layer comprises performing a plasma process using at least one of ammonia gas and nitrogen gas. [0231]-[0232] and preceding paragraphs. The reaction chamber temperature of approximately 300-500 degrees C is obtained [0231]. Removing the copper oxide and depositing the barrier layer may be performed in the same chamber [0235]-[0236]. Removing the copper oxide comprises heat treatment in an atmosphere of ammonia or nitrogen gas [0231]-[0232]. The copper barrier may comprise a nitride [0238].

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

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(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

8. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35

U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

9. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

10. Claims 4, 8-10 and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Noguchi (US 2003/0114000, dated 6/19/03, filed 11/14/02) in view of Agnello et al. (US 6,255,217, dated 7/3/01).

Noguchi shows the method substantially as claimed, and as described in the preceding paragraphs.

Noguchi lacks anticipation only in not teaching that: 1) the flow rate of nitrogen and ammonia is approximately 100 sccm to 200 sccm (claim 4); 2) the atmosphere of ammonia gas or nitrogen gas is introduced into a furnace at a flow rate of 5 to 20 slm (claims 8-9); 3) the copper nitride is deposited in a thickness of approximately 50 to 200 Angstroms (claim 10) and ; 4) the nitride layer is deposited in a thickness of approximately 50 to 200 Angstroms (claim 12).

Agnello teaches a similar copper treatment method for an interconnect, wherein the copper is treated with nitrogen and ammonia plasma, followed by subsequent barrier formation (column 3, lines 48-65; column 4, lines 1-50). Agnello emphasizes that the flow rates and other associated parameters vary and, depend on which conventional apparatus is used to treat the copper interconnect (column 4, lines 7-49). The claimed ranges for flow rates are covered, as well as temperatures and other process parameters.

It would have been obvious to one of ordinary skill in the art to have had the flow rate of nitrogen and ammonia be approximately 100 sccm to 200 sccm ; to have had the atmosphere of ammonia gas or nitrogen gas be introduced into a furnace at a flow rate of 5 to 20 slm ; to have had the copper nitride deposited in a thickness of approximately 50 to 200 Angstroms and; to have had the nitride layer be deposited in a thickness of approximately 50 to 200 Angstroms, in the method of Noguchi, with the motivation provided by Agnello, both explicitly and implicitly, in the statement that Agnello teaches that the flow rates and other associated parameters such as thickness of the deposited copper nitride layer and the nitride layer are associated with the method and apparatus of treatment. Therefore, the claimed ranges would be obvious to one of ordinary skill in the art to obtain, depending upon the means of treatment and length of duration of the copper interconnect layer.

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Conclusion

11. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. See the PTO 892 for relevant art discussing the copper oxide and passivation issues.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lynne A. Gurley whose telephone number is 571-272-1670. The examiner can normally be reached on M-F 7:30-4:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, John Niebling can be reached on 571-272-1679. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).


Lynne A. Gurley
Primary Patent Examiner
TC 2800, Art Unit 2812

LAG
August 5, 2004